OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **RAND POND** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The historical data (the bottom graph) show a *stable* in-lake chlorophyll-a trend. October chlorophyll concentrations were slightly higher than previous months, but were not of any alarming levels. Mean chlorophyll concentrations in Rand Pond have remained below the NH mean reference line for over ten years! While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are external and internal sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.

- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows a *slightly improving* trend in lake transparency. All transparency readings were above the average for NH lakes this season. The increase in rain the state experienced this season did not seem to affect the average transparency of the pond. The 2000 sampling season was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amounts of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the lower layer); the inset graphs show current year data. Phosphorus is the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth

over time. These graphs show an *improving* trend in the upper water layer, meaning levels are decreasing, and a *stable* trend in the lower water layer. Epilimnetic phosphorus concentrations remained quite low this season, and mean values were consistent with those seen last year. Hypolimnetic phosphorus concentrations in June were elevated and could be due to the turbidity of the sample. Samples contaminated with bottom sediment can cause increased phosphorus concentrations and yield inaccurate results. Results in August and October were back to normal, and mean phosphorus concentrations remain below the average for NH lakes. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- No metalimnion (middle water layer) samples were taken this season as they had been in the past. This was due to the lake being stratified into only two layers present, the epilimnion (upper water layer) and the hypolimnion (lower water layer). We suggest that volunteers continue testing only the epilimnion and hypolimnion, as we see no need to conduct any extra in-lake sampling.

- Inlet conductivity decreased again this season, but remains higher than desirable for the pond (Table 6). The increase in rainfall this season seemed to have helped flush the inlet and decrease the accumulation of nutrients. We continue to recommend testing the additional sites along the inlet established in the 1999 season to pinpoint nutrient inputs into the inlet.

- Overall, in-lake conductivity appears to be increasing over the years. Conductivity increases often indicate the influence of human activities on surface waters. Septic system leachate, agricultural runoff, iron deposits, and road runoff can all influence conductivity. It would be useful to uncover the reasons for increased conductivity as we continue to monitor the lake.

- *E. coli* originates in the intestines of warm-blooded animals (including humans) and is an indicator of associated and potentially harmful pathogens. Bacteria concentrations were non-existent at the boat launch (Table 12). If residents are concerned about septic system impacts, testing when the water table is high or after rains is best. Please consult the Other Monitoring Parameters section of the report for the current standards for *E. coli* in surface waters.

NOTES

- Monitor's Note (8/22/00): Water level high. Saw family of 6 ducks, one blue heron, one loon.

USEFUL RESOURCES

Stormwater Management and Erosion and Sediment Control Handbook. NHDES, Rockingham County Conservation District, USDA Natural Resource Conservation Service, 1992. (603) 679-2790.

The Wetlands Resource, WD-WB-7, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Answers to Common Lake Questions, NHDES-WSPCD-92-12, NHDES Booklet, (603) 271-3503.

Nonpoint Source Pollution and Stormwater Fact Sheet Package. Terrene Institute. (800) 726-5253, or www.terrene.org.

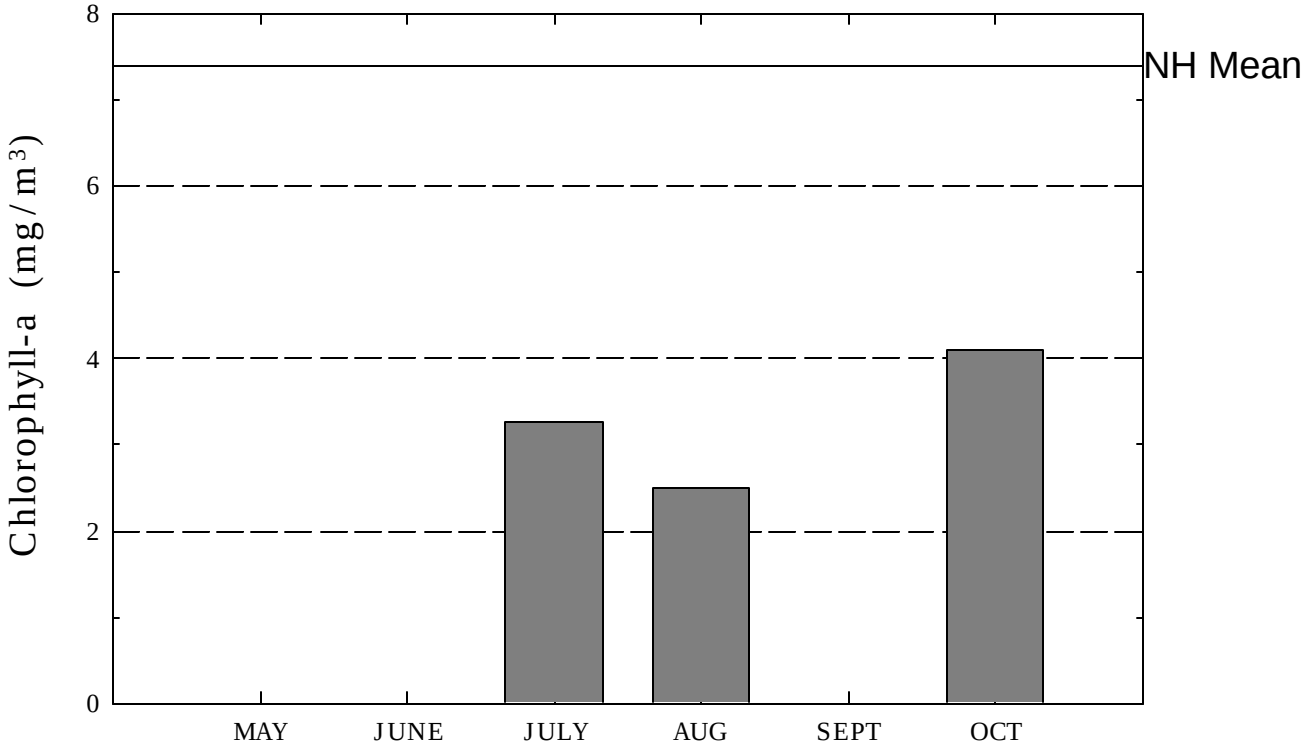
The Watershed Guide to Cleaner Rivers, Lakes, and Streams, Connecticut River Joint Commissions, 1995. (603) 826-4800

Road Salt and Water Quality, WD-WSQB-7, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

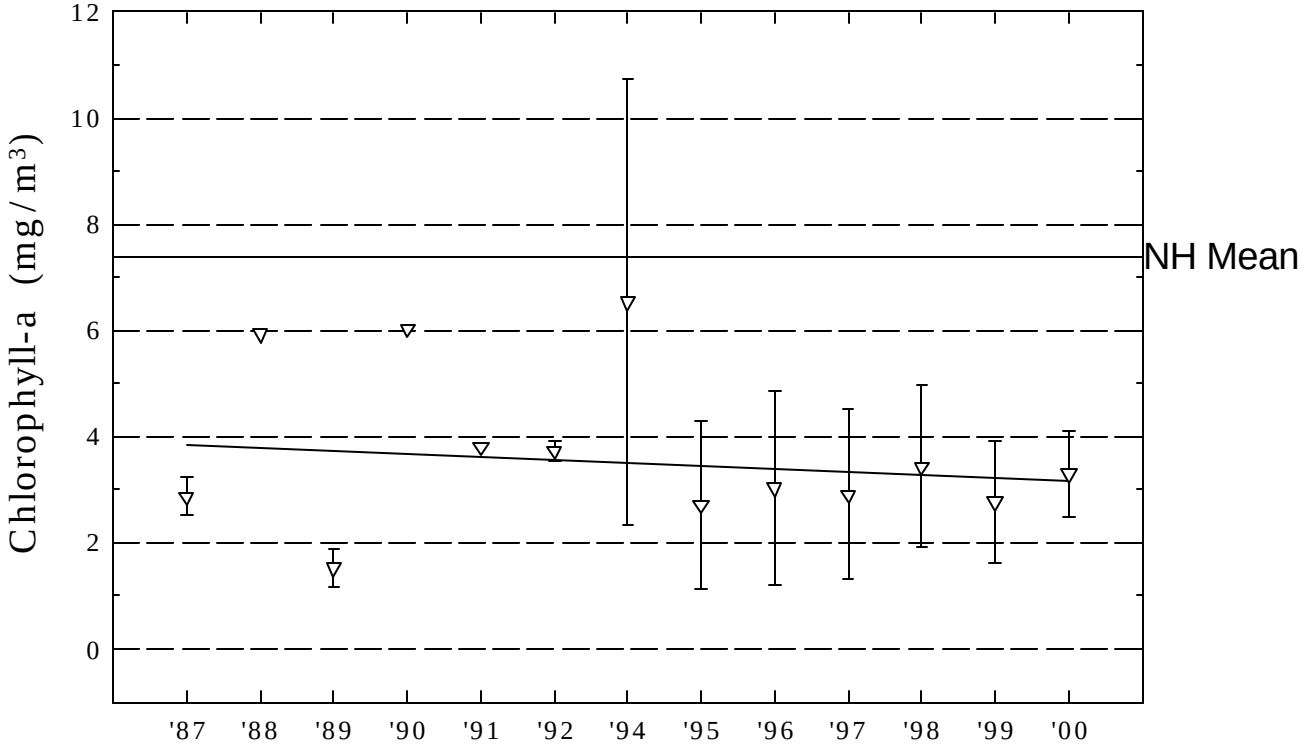
Through the Looking Glass: A Field Guide to Aquatic Plants. North American Lake Management Society, 1988. (608) 233-2836 or www.nalms.org

Rand Pond

Figure 1. Monthly and Historical Chlorophyll-a Results



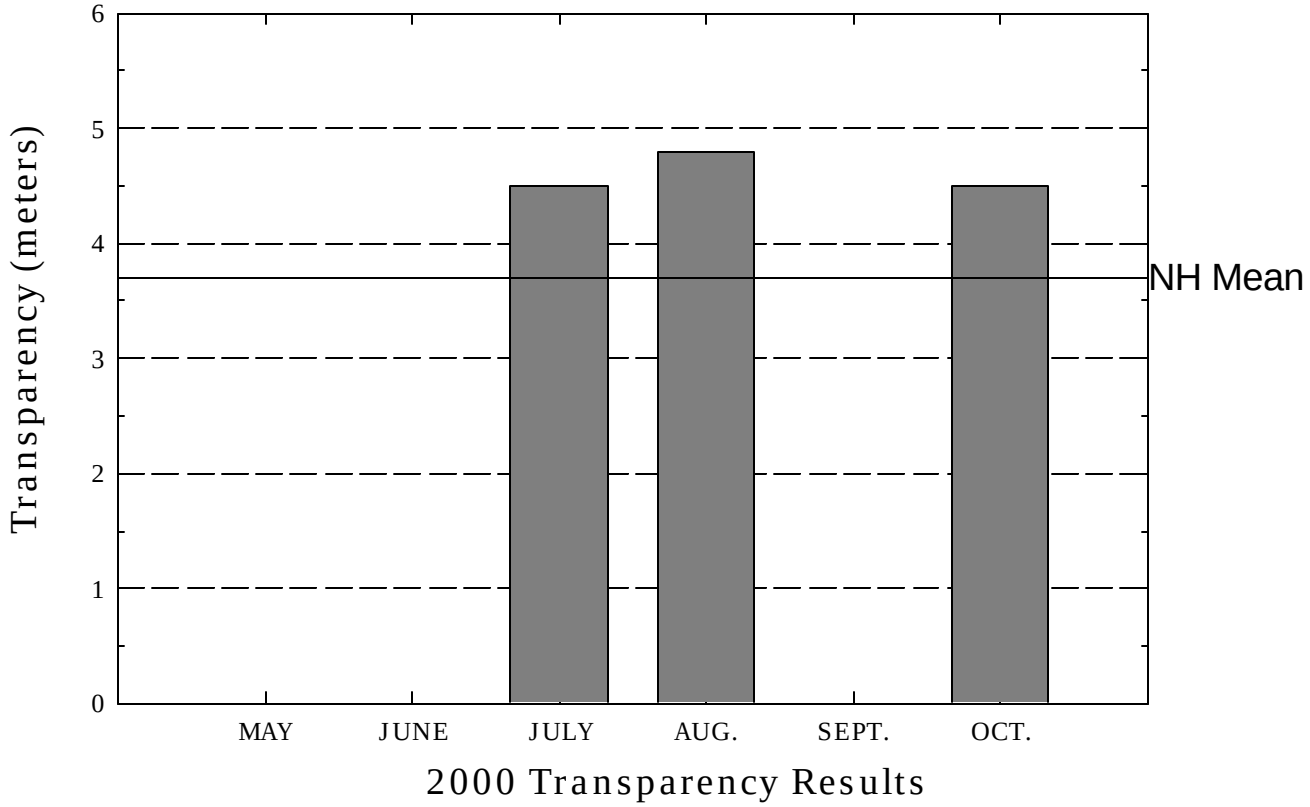
2000 Chlorophyll-a Results

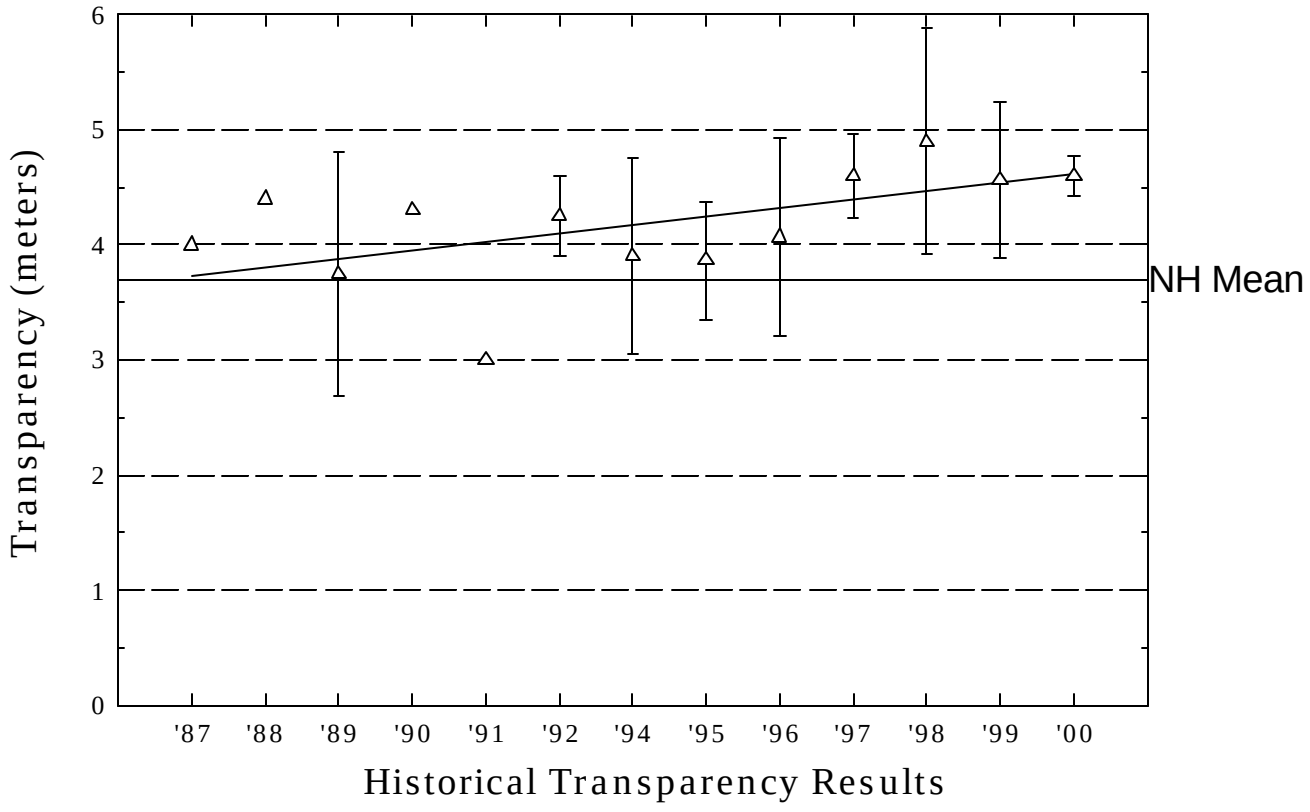


Historical Chlorophyll-a Results

Rand Pond

Figure 2. Monthly and Historical Transparency Results





Rand Pond

Figure 3. Monthly and Historical Total Phosphorus Data.

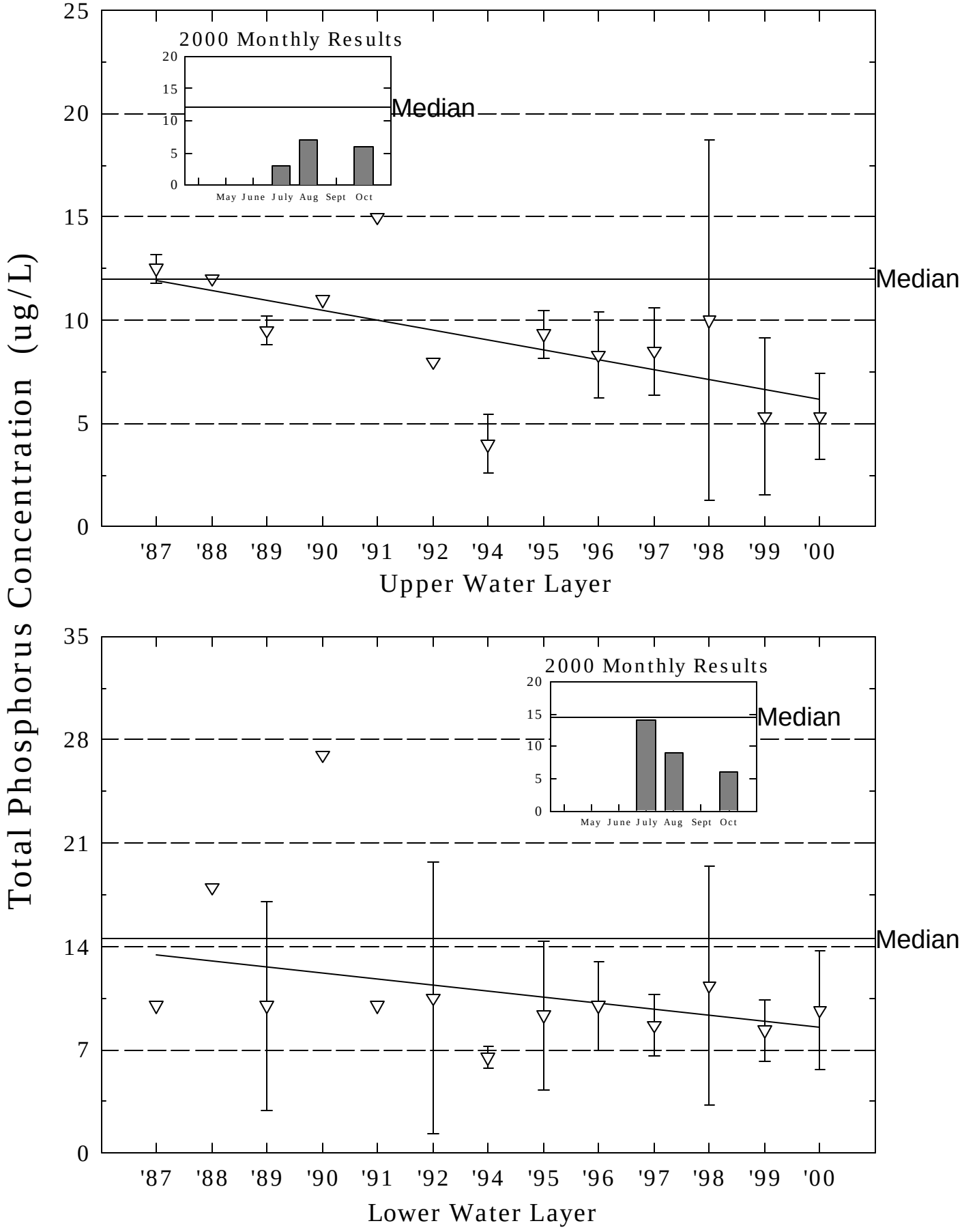


Table 1.

RAND POND

GOSHEN

Chlorophyll-a results (mg/m^3) for current year and historical sampling periods.

Year	Minimum	Maximum	Mean
1987	2.63	3.12	2.87
1988	5.93	5.93	5.93
1989	1.28	1.78	1.53
1990	6.04	6.04	6.04
1991	3.80	3.80	3.80
1992	3.59	3.86	3.72
1994	2.91	9.50	5.33
1995	1.23	4.38	2.72
1996	1.80	5.12	3.03
1997	1.83	4.74	2.90
1998	1.83	4.88	3.43
1999	2.01	4.08	2.77
2000	2.51	4.10	3.29

Table 2.

RAND POND

GOSHEN

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
07/08/1987	ASTERIONELLA	89
08/03/1988	ASTERIONELLA	79
08/11/1989	ASTERIONELLA	52
	CERATIUM	
	CHRYSOSPHAERELLA	
08/23/1990	ASTERIONELLA	82
08/27/1991	DINOBRYON	86
	ASTERIONELLA	12
07/28/1992	CHRYSOSPHAERELLA	39
	TABELLARIA	26
	ASTERIONELLA	22
08/12/1994	TABELLARIA	41
	ANABAENA	14
	DINOBRYON	13
08/23/1994	TABELLARIA	45
	MELOSIRA	14
	GLOEOCYSTIS	14
08/18/1995	MICROCYSTIS	45
	CERATIUM	17
	TABELLARIA	10
08/12/1996	ASTERIONELLA	93
	STAURASTRUM	1
	SYNEDRA	1
08/25/1998	TABELLARIA	36
	CERATIUM	35
	ASTERIONELLA	10

Table 2.

RAND POND

GOSHEN

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
08 / 18 / 1999	CERATIUM	33
	DINOBRYON	28
	TABELLARIA	22
08 / 22 / 2000	CHRYSOSPHAERELLA	38
	DINOBRYON	26
	ASTERIONELLA	

Table 3.

RAND POND

GOSHEN

Summary of current and historical Secchi Disk transparency results (in meters).

Year	Minimum	Maximum	Mean
1987	4.0	4.0	4.0
1988	4.4	4.4	4.4
1989	3.0	4.5	3.7
1990	4.3	4.3	4.3
1991	3.0	3.0	3.0
1992	4.0	4.5	4.2
1994	3.3	4.5	3.9
1995	3.3	4.3	3.8
1996	3.3	5.0	4.0
1997	4.3	5.0	4.6
1998	3.8	5.7	4.9
1999	3.8	5.1	4.5
2000	4.5	4.8	4.6

Table 4.

RAND POND

GOSHEN

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1987	6.89	7.20	7.02
	1988	7.18	7.18	7.18
	1989	6.75	7.22	6.92
	1990	6.96	6.96	6.96
	1991	7.10	7.10	7.10
	1992	6.25	7.02	6.48
	1994	6.34	7.04	6.66
	1995	7.08	7.30	7.17
	1996	6.90	7.03	6.96
	1997	6.54	6.96	6.77
	1998	6.69	7.00	6.85
	1999	6.70	7.11	6.86
	2000	6.84	7.12	6.96
HYPOLIMNION				
	1987	6.87	6.87	6.87
	1988	6.62	6.62	6.62
	1989	6.50	6.73	6.60
	1990	6.47	6.47	6.47
	1991	6.60	6.60	6.60
	1992	6.45	6.50	6.47
	1994	6.47	6.78	6.61
	1995	6.44	7.15	6.74
	1996	6.30	6.94	6.45
	1997	6.47	6.89	6.62
	1998	6.34	6.64	6.48
	1999	6.29	6.79	6.49

Table 4.

RAND POND

GOSHEN

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	2000	6.35	6.80	6.52
INLET ABOVE RD				
	1999	7.00	7.00	7.00
INLET AT PIPE				
	1999	6.89	6.89	6.89
INLET				
	1987	7.01	7.01	7.01
	1988	7.18	7.18	7.18
	1989	6.74	7.12	6.89
	1990	6.98	6.98	6.98
	1991	6.90	6.90	6.90
	1992	6.70	7.12	6.86
	1994	6.93	7.22	7.05
	1995	6.86	7.32	7.03
	1996	6.84	6.84	6.84
	1997	6.96	7.11	7.03
	1998	6.70	6.95	6.81
	1999	6.64	7.04	6.86
	2000	6.78	7.29	6.94
METALIMNION				
	1992	6.25	6.25	6.25
	1994	6.90	6.90	6.90
	1995	6.80	6.80	6.80
	1996	6.72	6.72	6.72
	1997	6.90	7.02	6.96

Table 4.

RAND POND

GOSHEN

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	1998	6.75	6.75	6.75
	1999	6.72	6.72	6.72
OUTLET				
	1987	7.02	7.02	7.02
	1988	6.98	6.98	6.98
	1989	6.75	7.02	6.86
	1990	7.07	7.07	7.07
	1991	7.00	7.00	7.00
	1992	6.47	7.00	6.66
	1994	6.92	7.32	7.08
	1995	7.04	7.11	7.07
	1996	6.66	6.98	6.79
	1998	6.88	7.06	6.94
	1999	6.82	7.02	6.91
	2000	6.90	7.31	7.06

Table 5.

RAND POND

GOSHEN

Summary of current and historical Acid Neutralizing Capacity.
Values expressed in mg/L as CaCO .

Epilimnetic Values

Year	Minimum	Maximum	Mean
1987	6.70	6.70	6.70
1988	6.80	6.80	6.80
1989	6.20	6.30	6.25
1990	5.50	5.50	5.50
1991	7.20	7.20	7.20
1992	7.40	7.50	7.45
1994	6.10	7.20	6.53
1995	6.60	8.80	7.67
1996	5.90	6.40	6.10
1997	5.80	6.40	6.07
1998	4.30	5.90	5.10
1999	5.60	5.80	5.73
2000	4.90	6.60	6.03

Table 6.

RAND POND

GOSHEN

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1987	44.3	46.1	45.2
	1988	46.8	46.8	46.8
	1989	50.0	50.1	50.0
	1990	50.8	50.8	50.8
	1991	54.2	54.2	54.2
	1992	59.0	63.2	61.1
	1994	74.4	75.6	74.8
	1995	71.5	79.5	75.8
	1996	70.2	73.0	71.9
	1997	65.4	69.5	67.5
	1998	72.5	74.7	73.9
	1999	73.3	77.6	75.9
	2000	71.9	72.9	72.3
HYPOLIMNION				
	1987	43.4	43.4	43.4
	1988	49.4	49.4	49.4
	1989	50.3	52.0	51.1
	1990	62.1	62.1	62.1
	1991	55.1	55.1	55.1
	1992	59.0	65.6	62.3
	1994	77.0	83.2	79.7
	1995	76.5	79.7	77.7
	1996	71.9	74.8	73.3
	1997	67.5	70.0	68.8
	1998	74.9	77.9	75.9

Table 6.

RAND POND
GOSHEN

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1999	73.8	78.2	76.5
	2000	73.2	78.6	75.2
INLET ABOVE RD				
	1999	60.5	60.5	60.5
INLET AT PIPE				
	1999	44.4	44.4	44.4
INLET				
	1987	61.1	61.1	61.1
	1988	49.3	49.3	49.3
	1989	48.2	49.3	48.7
	1990	108.3	108.3	108.3
	1991	54.9	54.9	54.9
	1992	55.7	57.0	56.3
	1994	60.7	63.1	61.9
	1995	60.9	65.2	62.5
	1996	74.6	74.6	74.6
	1997	56.7	56.8	56.7
	1998	68.2	172.3	127.1
	1999	64.5	200.0	110.4
	2000	75.0	94.3	87.6
METALIMNION				
	1992	59.0	59.0	59.0
	1994	75.3	75.3	75.3
	1995	71.9	71.9	71.9
	1996	69.6	69.6	69.6
	1997	66.4	69.4	67.9

Table 6.

RAND POND

GOSHEN

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1998	73.4	73.4	73.4
	1999	77.1	77.1	77.1
OUTLET				
	1987	42.7	42.7	42.7
	1988	46.6	46.6	46.6
	1989	49.4	70.6	60.0
	1990	50.4	50.4	50.4
	1991	55.8	55.8	55.8
	1992	58.0	64.2	61.1
	1994	75.1	75.2	75.1
	1995	72.4	80.9	76.7
	1996	70.5	72.5	71.5
	1998	73.0	74.4	73.5
	1999	72.8	76.8	74.8
	2000	72.1	73.2	72.6

Table 8.

RAND POND

GOSHEN

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1987	12	13	12
	1988	12	12	12
	1989	9	10	9
	1990	11	11	11
	1991	15	15	15
	1992	8	8	8
	1994	3	12	6
	1995	8	10	9
	1996	6	10	8
	1997	7	10	8
	1998	4	20	10
	1999	1	8	5
	2000	3	7	5
HYPOLIMNION				
	1987	10	10	10
	1988	18	18	18
	1989	5	15	10
	1990	27	27	27
	1991	10	10	10
	1992	4	17	10
	1994	6	26	13
	1995	4	14	9
	1996	7	13	10
	1997	7	11	8
	1998	4	20	11

Table 8.

RAND POND

GOSHEN

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	1999	6	10	8
	2000	6	14	9
INLET				
	1987	9	9	9
	1988	19	19	19
	1989	7	7	7
	1990	6	6	6
	1991	10	10	10
	1992	2	5	3
	1994	7	30	18
	1995	6	9	7
	1996	6	6	6
	1997	9	9	9
	1998	7	7	7
	1999	2	12	6
	2000	2	7	5
METALIMNION				
	1992	4	4	4
	1994	7	7	7
	1995	9	9	9
	1996	9	9	9
	1997	5	7	6
	1998	6	6	6
	1999	1	1	1
OUTLET				
	1987	9	9	9

Table 8.

RAND POND

GOSHEN

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	1988	21	21	21
	1989	4	9	6
	1990	11	11	11
	1991	13	13	13
	1992	5	22	13
	1994	10	24	17
	1995	5	19	12
	1996	6	10	8
	1998	5	20	10
	1999	6	6	6
	2000	5	9	7

Table 9.

RAND POND

GOSHEN

Current year dissolved oxygen and temperature data.

Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
		August 22, 2000	
0.1	20.9	8.7	96.9
1.0	20.7	8.7	96.7
2.0	20.7	8.6	96.2
3.0	20.6	8.6	95.9
4.0	20.6	8.6	95.9
5.0	20.4	8.3	92.2
6.0	20.0	6.1	67.1
6.5	17.6	0.5	4.9

Table 10.

RAND POND

GOSHEN

Historic Hypolimnetic dissolved oxygen and temperature data.

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
July 8, 1987	5.5	19.0	3.8	41.0
August 3, 1988	7.5	16.0	1.0	10.0
August 11, 1989	7.0	15.5	0.5	5.0
August 23, 1990	7.5	14.5	-0.5	-4.9
August 27, 1991	7.5	18.3	0.0	0.0
July 28, 1992	7.0	15.5	0.5	5.0
August 12, 1994	7.5	15.0	0.2	2.0
August 23, 1994	7.0	16.6	0.0	0.0
August 18, 1995	8.0	19.9	0.5	5.0
August 12, 1996	6.5	19.6	1.1	12.0
August 7, 1997	7.0	17.6	0.9	9.0
August 25, 1998	7.0	22.1	4.8	54.0
August 18, 1999	7.0	21.8	0.5	5.3
August 22, 2000	6.5	17.6	0.5	4.9

Table 11.

RAND POND
GOSHEN

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1992	1.0	1.0	1.0
	1994	0.7	0.7	0.7
	1995	1.5	4.5	3.0
	1996	0.7	1.4	1.0
	1997	0.4	0.8	0.5
	1998	0.6	0.9	0.8
	1999	0.3	1.0	0.7
	2000	0.3	2.0	1.1
HYPOLIMNION				
	1992	1.1	1.1	1.1
	1994	2.1	2.1	2.1
	1995	1.6	6.0	3.8
	1996	1.3	2.8	2.0
	1997	0.7	1.7	1.1
	1998	1.4	2.1	1.6
	1999	0.9	1.7	1.3
	2000	0.5	2.2	1.2
INLET ABOVE RD				
	1999	0.6	0.6	0.6
INLET AT PIPE				
	1999	0.8	0.8	0.8
INLET				
	1992	1.2	1.2	1.2
	1994	0.4	0.4	0.4
	1995	0.9	2.1	1.5
	1996	0.4	0.4	0.4

Table 11.

RAND POND

GOSHEN

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
INLET				
	1997	0.1	0.4	0.2
	1998	0.4	2.1	1.1
	1999	0.0	0.9	0.4
	2000	0.1	0.3	0.2
METALIMNION				
	1992	1.0	1.0	1.0
	1997	0.5	0.8	0.6
	1998	0.6	0.6	0.6
	1999	0.4	0.4	0.4
OUTLET				
	1992	2.2	2.2	2.2
	1994	1.1	1.1	1.1
	1995	1.3	2.2	1.7
	1996	1.0	1.0	1.0
	1998	0.5	1.1	0.8
	1999	0.8	1.7	1.2
	2000	0.3	1.0	0.7

Table 12.

RAND POND

GOSHEN

Summary of current year bacteria sampling.
Results in counts per 100ml.

Location	Date	E. Coli See Note Below
BOAT LAUNCH		
	August 22	0

NOTE: "<" means "less than" and ">" means "greater than"